MITVIM
The Israeli Institute for Regional Foreign Policies

Recommendations for Essential Infrastructure and Healthcare in the Gaza Strip

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A. Introduction

This paper examines elements of essential infrastructure in the Gaza Strip - energy, water, sanitation, and the health system – in the face of the ongoing war. Our aim is to inform decision-makers about the extent of destruction to physical and institutional infrastructure resulting from the Israel-Hamas war. We propose ways to address immediate needs and rebuild for the future, envisioning a sustainable "day after." The enormous infrastructural damage in Gaza directly exacerbates the humanitarian crisis in the Gaza Strip, impacting access to clean water and healthcare for Gaza's population, as well as for 134 Israelis held captive by Hamas and other groups. This document offers recommendations for urgent action to address humanitarian challenges and rebuild for the long term. These recommendations, formulated by Israeli professionals, stem from extensive discussions in small working groups and broader forums.

Following an overview of guiding principles, the paper details recommendations by infrastructure type: energy, water, sewage, and health. Each chapter comprises several sections: (1) Pre-war status quo; (2) The present situation (after more than five months of war); (3) Recommendations for immediate, medium, and long-term actions, including off-grid infrastructure; (4) Proposed implementation mechanisms.

B. Guiding principles

The following principles, drawn from extensive experience in rehabilitation processes elsewhere, guided the experts' approach.

- **Interdependence between infrastructure types**. This document categorizes its recommendations into four sectors (energy, water, wastewater, and health); each vital for human habitation. However, it also acknowledges the significant interdependence among these areas. For instance, energy is necessary to operate water and wastewater systems, which, in turn, affect access to clean water and wastewater treatment quality. This directly impacts population health and the safety, availability, and assurance of food and nutrition.

- **Repairing and upgrading the infrastructure and health system is essential to prevent the spread of infections and diseases into Israel**. Prolonged pollution due to the inactivity of essential infrastructure poses risks to natural water sources, desalination plants, and water pumping stations in Israel. Furthermore, diseases like polio and measles, transmitted in overcrowded and unhygienic conditions lacking adequate water, food, and medical services, could escalate into epidemics and affect Israelis as well. Israel and Gaza share a common environmental system,

emphasizing the interdependence of environmental health and the well-being of people on both sides of the border.

- **Immediate actions should align with long-term planning.** _Planning and constructing permanent infrastructure significantly influences spaces, creating fait accompli ("lock-in") situations that constrain future decisions and flexibility. Therefore, infrastructure planning for the short and medium term must be derived from long-term considerations. This document addresses long-term planning in each subject area, enabling the extraction of necessary insights for immediate actions from long-term perspectives.

- **The physical existential infrastructure and political-diplomatic aspects are inherently interconnected.** Long-term planning, as proposed in this document, encompasses physical infrastructure, as well as the social, economic, and political dimensions derived from envisioned futures, while considering evolving population needs. Consequently, planning identifies regional and local actors suitable for cooperation in humanitarian efforts and infrastructure rehabilitation.

- **Rehabilitating life-sustaining infrastructure can, and should, serve to undermine Hamas.** The question of executive and administrative apparatus concerning health and infrastructure profoundly impacts Israel's support for repairing and reconstructing water, sewage, energy, and health systems in Gaza. The objective is to identify alternative mechanisms to Hamas, both to sideline Hamas from power and to facilitate genuine and effective rehabilitation for the population. Therefore, in each professional domain, a comprehensive map is created, outlining all potential avenues of action and entities that can form active and effective professional bodies in the field.

- **Off-grid infrastructure holds significant importance, especially in the immediate time frame**. During and after periods of hostilities, mobile infrastructures not tethered to centralized grids play a crucial role. This includes mobile clinics, rainwater collection facilities, small desalination plants, mobile wastewater treatment plants, solar panels, compost services and more. These resources offer immediate responses, and, with forward-looking planning, can integrate into existing infrastructure, enhancing community and local independence. Consequently, each chapter addresses existing technologies relevant to the respective infrastructure.

- **Specific solutions must be tailored to Gaza's diverse geographic areas**. Due to the circumstances of the war, different regions in the Gaza Strip face varying security and civilian conditions. Factors such as the controlling entity on the ground, civilian mobility, population density, access to humanitarian aid, infrastructure status, and availability of water and food differ across these areas. Therefore, immediate-term solutions should be region-specific. For example, infrastructure and health solutions in the Northern Gaza Strip, characterized by sparse civilian population and significant control by the IDF, will differ from those in the Mawasi area near the sea, which has a dense civilian population.

- **It is imperative to carefully plan, and facilitate, a gradual shift away from reliance on subsidies and external management, towards local management and ownership.** Substantial contributions from the international community will be necessary in the early years of reconstruction. However, all key stakeholders should

actively assist Palestinians in constructing economic models, emphasizing the transfer of responsibility for infrastructure, buildings, and services to local governing bodies. This approach will ensure the long-term sustainability of all projects and initiatives. Consequently, as the economy and population stabilize, residents will be empowered to both pay for the services they receive and assume ownership of the infrastructure and buildings. Relying solely on external funding is not viable, and donor countries will face challenges in sustaining it without limitations. Moreover, there is significant political value in preventing the perpetuation of refugee status and dependence.

- **Building infrastructure necessitates thoughtful planning and spatial execution**. To ensure quality reconstruction, the planning process in the Gaza Strip should be part of a spatial-regional approach that incorporates the western Negev. Establishing a centralized coordination and planning mechanism under regional sponsorship would be invaluable as the integrating entity. Such a mechanism would assess the feasibility of long-term projects, prioritize initiatives, direct investments, engage in dialogue with local residents, and more.

C. Recommendations according to type of infrastructure

This chapter offers recommendations for energy, water, wastewater, and health infrastructure, structured into four parts: (1) Pre-war status quo (2) The present situation (after more than six months of war); (3) Recommendations for immediate, medium, and long-term actions, including off-grid infrastructure; (4) Proposed implementation mechanisms.

Energy

Pre-war status quo

a. Gaza's energy demand was 550 megawatts (MW), while the actual supply was around 200 MW (120 MW of electricity from Israel, 60 MW from Gaza's diesel-based power plant, and the rest from private generators and small solar power systems).

b. Three distinct electricity networks operated in the Gaza Strip, each fueled by a different source: electricity generated in Israel, transmitted into Gaza's local grid under the responsibility of the Gaza Electricity Distribution Company (GEDCO); electricity generated by Gaza's diesel-fired power plant; and electricity transmitted from Egypt (which ceased in 2018).

c. The majority of Gaza's electricity came from Israel via 10 power lines, each capable of transmitting 12 MW, totaling 120 MW.[1]

d. The Gaza Power Plant, situated in the central Gaza Strip, was owned by a private Palestinian company (CCC) and the Palestinian Investment Fund, which also held rights to the Gaza-Marine gas field.

[1] Will Todman, Joseph S. Bermudez Jr and Jennifer Jun. *Gaza's Solar Power in Wartime*. November 21, 2023. Center for Strategic and International Studies (CSIS). https://www.csis.org/analysis/gazas-solar-power-wartime

e. The fuel for the Gaza Power Plant was purchased in Israel by Qatar and transported via the Kerem Shalom Crossing into Gaza.[2] It supplied three turbines, collectively generating 65-75 MW.

f. Israeli planning authorities, under the National Outline Plan, approved a detailed plan to connect the Gaza Power Plant to Israel's gas reservoirs through a transmission pipeline, advancing the project to the implementation stage.[3]

g. The Gaza Electricity Distribution Company (GEDCO) was responsible for purchasing, selling, and distributing electricity.

h. Egypt ceased supplying electricity to the Gaza Strip in February 2018,[4] citing concerns about ongoing dependence and connectivity.

i. On the eve of the war, approximately 25% of Gaza's power supply came from private systems, including small generators or solar systems.[5]

Wartime electricity infrastructure (as of February 2024)

- Although the Gaza Power Plant turbines were not damaged in the war, there was damage to buildings and secondary equipment. As of October 11, the Gaza Power Plant has been out of operation due to a lack of fuel.[6]

- Israel severed three power lines to Gaza.

- As of February 2024, 62% of the power lines supplying Gaza have been damaged or disconnected.[7]

- The fighting damaged numerous solar systems, primarily rooftop installations, along with two large solar system infrastructures (located in the industrial zones of Gaza City and the Karni Crossing). Additionally, solar infrastructure that served the desalination plant in central Gaza was affected.[8]

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[2] *Gaza Up Close.* June 28, 2023. Gisha - Legal Center of Freedom of Movement. https://features.gisha.org/gaza-up-close/

[3] *Report to the Ad Hoc Liaison Committee,* May, 2022. Office of the Quartet. https://www.quartetoffice.org/files/Office%20of%20the%20Quartet%20Report%20to%20the%20AHLC%20-%20May%202022.pdf

[I believe I added another ref from Reuters in Hebrew version]

[4] Ibid.

[5] Will Todman, Joseph S. Bermudez Jr and Jennifer Jun. *Gazas Solar Power in Wartime.* November 21, 2023. Center for Strategic and International Studies (CSIS). https://www.csis.org/analysis/gazas-solar-power-wartime

[6] Ibrahim Dahman. *Gaza's sole power station stops working as fuel runs out, after Israel orders 'complete' blockade.* October 11, 2023. CNN. https://edition.cnn.com/2023/10/11/middleeast/gaza-power-plant-shuts-down-intl/index.html

[7] World Bank Group. *Note on the Impact of the Conflict in the Middle East on the Palestinian Economy.* February, 2024. The World Bank Economic Monitoring Report. https://thedocs.worldbank.org/en/doc/db985000fa4b7237616dbca501d674dc-0280012024/original/PalestinianEconomicNote-Feb2024-Final.pdf

[8] Will Todman, Joseph S. Bermudez Jr and Jennifer Jun. *Gazas Solar Power in Wartime.* November 21, 2023. Center for Strategic and International Studies (CSIS). https://www.csis.org/analysis/gazas-solar-power-wartime

- Solar power installations in combat zones, many of which were used to power Hamas tunnels, have been destroyed. The damage to electricity infrastructure is estimated at $280 million.[9]

Type of fuel	September 2023	October 2023	November 2023	December 2023	January 2024
Diesel, petrol (millions of liters)	11.48	4.64	1.41	2.57	1.91
Cooking gas (millions of kgs)	7.38	2	0.61	1.49	2.77
Gaza Power Plant (millions of liters)	12.2	3.8	0	0	0

[10] Entry of fuel into the Gaza Strip – prior to the war and through January

Between October 7 and November 14, no fuel entered the Gaza Strip.[11] The first trucks permitted to enter the Gaza Strip after the beginning of the current war, on November 15, carried 24,000 liters of fuel; sufficient for only 9% of life-sustaining activities. On December 7, Israel approved increasing daily fuel supply to 60,000 liters.[12] As of January 31, 2024, only 10% of fuel deliveries north of Wadi Gaza and 71% south of Wadi Gaza had been successful.[13]

Recommendations

Immediate term:

- Promptly assess the physical and political feasibility of restoring electricity supply from Egypt. The connection from Egypt reaches the Rafah area, which is particularly relevant due to the large number of displaced Gazans sheltering there. As part of the comprehensive post-war arrangement, power distribution could be initially established from both Israel and Egypt to Gaza.

[9] World Bank Group. *Note on the Impact of the Conflict in the Middle East on the Palestinian Economy.* February, 2024. The World Bank Economic Monitoring Report. https://thedocs.worldbank.org/en/doc/db985000fa4b7237616dbca501d674dc-0280012024/original/PalestinianEconomicNote-Feb2024-Final.pdf

[10] OCHA. *Gaza crossings: movement of people and goods.* 2023. OCHA. https://www.ochaopt.org/data/crossings

[11] Yusri Mohamed and Maya Gebeily. *First fuel since start of war delivered to UN in Gaza.* November 16, 2023. Reuters. https://www.reuters.com/world/middle-east/first-truck-with-fuel-begins-crossing-into-gaza-egypt-2023-11-15/

[12] Toi Staff and Agencies. *Following US pressure, approves increase of fuel deliveries to Gaza.* December 7, 2023. The Times of Israel. https://www.timesofisrael.com/following-us-pressure-israel-approves-increase-of-fuel-deliveries-to-gaza/

[13] OCHA. *Humanitarian Access Snapshot - Gaza Strip.* February 6, 2024. OCHA. https://www.ochaopt.org/content/humanitarian-access-snapshot-gaza-strip-end-january-2024

- Transfer diesel fuel to operate the Gaza Power Plant, and obtain up-to-date information from the Israeli military about the condition of the population and infrastructure in the area powered by the plant.

- Transfer electricity from Israel after COGAT examines and maps the lines connected to Hamas tunnels and those that are not. Electricity can be directed into specific agreed areas, for example, through the Erez Crossing.

- Introduce generators, armored vehicles and diesel fuel for operation, and other mobile solutions such as solar panels.

Intermediate phase after cessation of hostilities:

- Establish a stable electricity connection from Israel to recognized shelter areas, utilizing existing power lines or extending transmission lines. Promote infrastructure connections for future planned residential areas, while considering solar systems for other areas.

- Repair power transmission lines and install monitoring systems in critical infrastructure and hospitals.

Long-term perspective:

- **Expand the Egypt to Gaza connection**. European donor states have previously offered to finance electricity transmission through the Sinai Peninsula to Gaza, including necessary infrastructure construction. This project could also involve infrastructural development in the Sinai region. Regional funding, and other incentives can make the project acceptable for Egypt. Reassurances regarding security arrangements for the transmission system and the benefits of renewing and upgrading power transmission to Gaza may be necessary for Egypt's cooperation.

- **Develop gas projects** to expand independent electricity production in the Gaza Strip, serving as a transitional stage before advancing a strategic plan for transitioning to renewable energy:

  a. Resuming the Gaza Gas Project (G4G) entails connecting the Gaza Power Plant to the Israeli gas system. Initially proposed by the Quartet in 2015, since 2022 the project has been led by the Palestinian Authority and Israel, with support from the EU, Qatar and the US. The planned gas pipeline is intended to carry approximately 30% hydrogen in the total gas mix. Further examination is necessary to determine whether the current funders will remain involved or if other players, such as Saudi Arabia and/or the United Arab Emirates, will take on the project.

  b. Developing the Gaza Marine gas field by the Palestinian private sector, in cooperation with the Palestinian Authority and Egypt, to whom the gas is intended to be exported. Egyptian companies have already signed preliminary agreements with the Palestinians regarding this endeavor.

- **Promoting renewable energies**. Consideration should be given to constructing solar fields designated for Gaza in several areas: a designated solar field in the Sinai, a solar field in the border area (ARA), a solar field in Area C of the West Bank (where

electricity from the West Bank to Gaza would be supplied through the Israeli grid), and a solar field in Israel's Negev Desert. Additionally, the possibility of importing renewable energy-based electricity from Saudi Arabia should be examined. Planners should bear in mind that the actual efficiency output of a solar system typically ranges from 15% to 20%, and current technology doesn't support wind energy potential in the Mediterranean. The Red Sea region offers more promise in this regard. Israel will likely need to maintain the proposed transmission systems mentioned above. A comprehensive feasibility study should explore these options, as well as the potential benefits of establishing a regional electricity grid, rather than just relying on a system of swaps.

- **Enhancing independent energy supply**. When repairing or constructing new facilities, energy capacity must be increased to achieve two primary objectives: a. Improved self-sufficiency to decrease reliance on the overall rehabilitation plan; b. Greater autonomy of these facilities, which will reduce their operating costs, thereby directly impacting the expenses for Gazans.

- **Establishing a unified north-south electricity transmission backbone infrastructure** in the Gaza Strip could enhance the efficiency of the electricity system and facilitate alternation between existing electricity sources, including independent production and imports from Israel and Egypt.

- **Transitioning from a refugee-based lifestyle to permanent residence**. Reconstruction efforts should prioritize the development of permanent residential neighborhoods over refugee camps. These new buildings must be designed to be efficient and conducive to productivity. Various economic models could be explored for this purpose. The planning process should prioritize sustainability, not only for the buildings themselves but also for public and open spaces. Donor countries will likely seek a sustainable economic model to prevent long-term economic dependency.

- **Emphasizing energy efficiency and green building and rebuilding**. If European donors finance construction projects, they are likely to prioritize energy efficiency and green building practices. Donor countries must also ensure alignment on construction standards, taking into account the involvement of other donors in the process.

Potential implementation partners

- Prominent energy sector figures left Gaza after Hamas took over due to their affiliation with Fatah. If they return under a political agreement, their familiarity with the system, and their relevant expertise, could be utilized effectively.

- Private Palestinian companies own various energy assets in Gaza, including the power plant. With suitable guarantees in place, these companies could serve as intermediaries in reinvesting in the electricity sector in the Gaza Strip.

- Several international bodies specialize in executing large-scale infrastructure projects. For instance, the United Nations Office for Project Services (UNOPS) offers infrastructure, procurement, and project management services. The World Bank possesses comparable capabilities.

- The international private sector could also contribute to fundraising and project execution.

- Several countries possess proven expertise in promoting projects, particularly in the field of energy in Palestinian areas. These include Norway, the Netherlands, the United States, the European Union, and Japan.

- Several Palestinian Authority agencies could contribute valuable knowledge and expertise to the rehabilitation of the electricity sector. These include the Palestinian Ministry of Energy and the PETL Network Management Company.

Water

Pre-war status quo

According to figures provided by the Palestinian Water Authority (PWA), water consumption in 2021, encompassing the private, industrial, and agricultural sectors, totaled about 215 MCM, with 113 MCM allocated for private consumers. However, in practice, the volume of potable water, comprising small amounts of reasonable quality groundwater, Israeli-supplied water, and desalinated water, only amounted to approximately 40 MCM per year. Until the outbreak of the war, Gaza's water sector relied on three main sources:

- The coastal aquifer has historically served as Gaza's main water source. However, extensive over-pumping of numerous wells across the enclave has led to salinization and a significant decline in water quality. According to figures from the Palestinian Water Authority, in 2021, the coastal aquifer supplied approximately 192.5 MCM for Gaza's water sector, accounting for around 90% of consumption. Only about 3% (about 6 MCM per year) originated from a limited number of wells in the northern Gaza Strip or wells equipped with desalination and purification devices. These sources provided potable and cooking water, covering roughly 15% of Gaza's potable water consumption. The remaining groundwater was utilized for laundry, washing, and various industrial and agricultural purposes, albeit at a limited level.

- Israel's water supply served as the second largest source of water for the Gaza Strip. According to Mekorot, Israel's national water company, Israel transferred 18.5 MCM to the Gaza Strip in 2022, accounting for approximately 12% of that year's water consumption, but covering about 46% of the potable water demand. This water was delivered through three pipelines: one pipeline near Kibbutz Nahal Oz which was upgraded in 2019, and two older pipelines to the south near the towns of Bani Said and Bani Suheila in the central and southern Gaza Strip. The two older pipelines have an annual maximum capacity of 5 MCM, but are unable to reach their full capacity due to the condition of the infrastructure inside the Gaza Strip.

- A third water source in Gaza comes from three short-term low-volume (STLV) desalination plants, located, respectively, in the southern Gaza Strip, Gaza City, and Deir al-Balah. These plants offer a temporary and quicker solution compared to the construction of a large desalination plant. According to Palestinian Water Authority figures, in 2021, 7.5 MCM (approximately 3% of consumption and 39% of potable water) were desalinated in Gaza. The Office of the Quartet expected the production capacity of these facilities to increase to 12 MCM per year by 2023, with further development potentially raising the production capacity to 30 MCM annually. Another plan prior to the outbreak of the war involved diluting desalinated water with brackish groundwater to provide a total annual supply of potable and usable water amounting

to 60 MCM. However, the construction of a major international desalination plant in the Gaza Strip (GCDP) was suspended in 2023.

Even prior to the war, Gaza's water transmission infrastructure suffered from poor conditions, leading to substantial water loss. According to figures from the Palestinian Water Authority, approximately 48.8 MCM, or about 23% of the total water supply, were lost in this manner in 2021. The functionality of the water transmission system relied heavily on the availability of electricity or fuel, crucial for operating discharge pumps, desalination plants, wells and treatment plants. In recent years, some segments of the transmission infrastructure underwent rehabilitation during the construction of the central desalination plant.

Wartime water infrastructure (as of March 2024)

Shortly after the October 7 attacks, Israel announced the cessation of its electricity and water supplies to Gaza. Although the flow of water through the two southern pipes eventually resumed, Israel did not reinstate the power supply or water through the northern pipeline. One of the two pipes supplying water from Israel was shut down at the beginning of January and remained awaiting repair as of March. The third pipeline, in Bani Said, currently supplies approximately 10,000 cubic meters a day, which is about 70% of its original supply potential. Regarding desalination plants, operations ceased shortly after the war began. However, with assistance from international organizations, the two southern plants resumed partial operations, albeit at a significantly reduced volume compared to their potential. Together, these two facilities produce roughly 3,315 cubic meters per day. Additionally, a desalination plant constructed by the UAE at the onset of the war on the Egyptian side of the Rafah border supplies the Gaza Strip with a daily quantity of 2,400 cubic meters. Simultaneously, some 45,000 cubic meters are reportedly supplied through municipal, private, and UNRWA-managed water wells. As of March 13, the potable water available to Gaza residents amounted to only about 16% of the supply before October 7, and even less if only potable water is considered).[14]

The critical shortage of drinking water in the Gaza Strip is exacerbated by several factors. Firstly, there is a lack of fuel for generators and other power sources needed to operate transmission pumps. Additionally, a significant percentage of the transmission pipes, especially in the northern Gaza Strip, have been damaged. This damage restricts the flow of water from its sources to distribution and consumption points.

Recommendations

Immediate term:

Ensuring the minimum water supply for the entire population according to World Health Organization standards, which recommend about 15 liters per day per person, with approximately 3 liters being potable. This can be achieved by implementing the following measures:

- **Local and independent desalination and purification solutions.** In addition to restoring the flow from Israel, immediate relief efforts should focus on implementing technical measures to enable desalination of seawater or purification of groundwater in local wells, including brackish water. A relevant model in this regard could be the

[14] Wash Cluster Mom 13th March 2024. UNICEF

desalination plant installed by the UAE on the Egyptian side of the Gaza border. Given the immediate challenges and population movements, emphasis should be placed on systems disconnected from the electricity grid and, wherever feasible, those that can be transported along with population centers. Groundwater purification may also require the sufficient introduction of disinfectants in accordance with accepted standards. Air-to-water technology, which was already available in Gaza on a limited scale before the war, is yet another relevant solution to alleviate the immediate shortage of drinking water. This off-grid solution enables local supply of drinking water where the need is significant, offering high mobility and remote monitoring capacity.

- **Solutions for transporting water to areas in need.** Given the damage to transmission infrastructure and the population concentration in areas where the water transmission network deployment is insufficient (such as Rafah and Muasi areas as of early February), efficient distribution measures are necessary. This could involve utilizing tankers and constructing temporary reservoirs to ensure the effective delivery of drinking water.

Intermediate phase after the cessation of hostilities:

As the intensity of the fighting gradually decreases, and depending on the locations of the bulk of the population, several steps will be necessary to prepare for the full reconstruction of the Gaza Strip:

- **Rehabilitating damaged infrastructure.** Water infrastructure, including the pipe network and pumps, and other facilities, has sustained significant damage. Repairs to the transmission system must be carried out in a manner that supports post-war reconstruction and enables broader connectivity of residential, commercial, and industrial areas to the water network.

- **Fully resuming the flow of water from Israel.** While the long-term goal is to reduce Gaza's dependence on Israeli supplies, in the intermediate stage, the flow of water from Israel remains the most accessible source of potable water. Resuming this flow will necessitate not only a political decision but also the entry of technical teams to repair the damaged pumping and transmission infrastructure on the Gaza side of the border.

- **Resuming the full capacity operation of small desalination plants** (including repairing the damage to the Gaza City desalination plant. This can be achieved by supplying fuel and the missing spare parts that are currently limiting their overall capacity. In the intermediate phase, and until more significant water production plants are established, consideration should be given to revisiting the plans of the international community to upgrade the existing facilities and dilute the water they produce with groundwater so as to double the output of their potable water.

Long-term perspective:

As the post-war political framework stabilizes, concerted efforts will be needed to better address Gazans' water needs and enhance regional stability and integration in the Gaza Strip.

- **Increasing the amount of available potable water.** In conjunction with rehabilitating the pre-war water sources, which were low compared to regional standards, steps should be taken to augment the water supply for the population. This will involve constructing small desalination plants alongside existing facilities, potentially integrating them with dilution facilities to boost water availability. Additionally, measures will be necessary to enhance the treatment of groundwater unsuitable for drinking and to explore the feasibility of additional water supply from Egypt and Israel.

- **Resumption of work and funding for the GCDP** (Gaza's main desalination plant) and related infrastructure construction: The GCDP project has faced significant delays and ultimately stalled in 2023 due to financial challenges, difficulties in importing dual-use materials (metals, chemicals, electronic components, raw materials for construction), and political instability. Completion of this initiative, aimed at producing 55 MCM of water annually in its first phase (with a similar volume of desalination in the second phase), could provide more than 50% of the WHO's recommended drinking water per capita. Preparation for the second phase of the project, which involves upgrading the facility to allow Gaza to join Project Prosperity as part of a comprehensive regional initiative, should begin at the planning stage. This upgrade has the potential to transform the Gaza Strip into a water exporter to the Sinai, the West Bank, and Israel. The project should be designed to ensure maximum efficiency.

- **Rehabilitation of the coastal aquifer.** Gaza's groundwater is unfit for drinking due to over-pumping and salinization in most areas. Constructing small desalination plants in Israel along the border with Gaza could improve the quality of groundwater by draining salts from the upper level of the shared aquifer. A similar project is already underway in Israel in the eastern region of the aquifer. In the long term, a rehabilitated aquifer will enhance the availability of freshwater resources.

Potential implementation partners (also valid for wastewater treatment):

In addition to extensive international aid for water and sewage response and rehabilitation efforts, it is crucial to involve experienced professionals in Gaza in the reconstruction activities. For instance, management and implementation of the plans could be entrusted to the Coastal Municipalities Water Utility (CMWU), which has ties to the Palestinian Water Authority controlled by the Palestinian Authority. CMWU is a veteran professional body familiar with and recognized by Israeli authorities, with which it engages in dialogue on relevant issues. Assigning CMWU responsibility for the rehabilitation of Gaza's water and sewage systems could, to some extent, circumvent Israeli objections to a politically affiliated Palestinian entity administering the Gaza Strip. This approach would allow these critical steps to proceed even without agreements on the political future of Gaza.

Wastewater

Pre-war status quo

On the eve of the war, six sewage treatment plants operated in the Gaza Strip: oxidation ponds in Beit Lahiya, a new facility in the northern Gaza Strip near Beit Hanoun, and plants in Gaza City, Al-Bureij, Khan Yunis, and Rafah. Significant progress had been made in the construction and upgrading of these facilities in the years before the war, leading to a notable increase in the scope of wastewater treatment. This progress even allowed Gazans to swim

in the sea in 2022, for the first time in about a decade. However, wastewater treatment faced significant challenges due to limited connectivity of households and other facilities, particularly in the southern Gaza Strip. As a result, some plants failed to reach the treatment quota due to lack of sufficient drainage infrastructure.

Wartime sewage infrastructure (as of March 2024)

The war has inflicted significant damage on Gaza's sewage system. All treatment plants were shut down shortly after October 7 due to a lack of fuel. While some facilities have sporadically resumed partial operation, mainly in the southern Gaza Strip, reports from international agencies indicate that several facilities, notably those in Al-Bureij, Khan Yunis, Gaza City, and the northern Gaza Strip, suffered moderate to severe damage from the fighting. The World Bank reports that the sewage treatment plant in the northern Gaza Strip, completed only a few years ago, was destroyed. These reports raise concerns about damage to the sewage transmission infrastructure and pumping systems, paralleling the damage seen in the water infrastructure, particularly in the northern Gaza Strip. Reports have indicated instances of leakage and the flow of raw sewage onto surfaces and streets following the shutdown of sewage pumps.

Recommendations

Immediate term:

Solutions for the absorption and treatment of wastewater in temporary population centers, which mostly lack proper infrastructure, are vital. Several options could be explored. Firstly, ensuring the availability of mobile hygiene and sanitation facilities, such as toilets, compost toilets, and showers is essential. Additionally, mobile treatment devices that do not rely on electricity and sewage grid hookups, such as those mounted on trucks, must be made available. These portable facilities can be strategically deployed based on the location of temporary population centers. Furthermore, exploring the disposal of wastewater into cesspits or reservoirs is crucial. These cesspits or reservoirs can then be emptied by truck to existing or temporary treatment facilities. Alternatively, wastewater can be discharged into the sea to prevent accumulation in densely populated areas. In the medium term, the possibility of wastewater treatment in Israel could be considered, contingent upon a thorough assessment of political, economic, infrastructural, and environmental feasibility.

Intermediate phase after the cessation of hostilities:

Reconstruction measures and a return to the pre-war status quo are imperative. The reconstruction process will need to be tailored to the population’s location and carried out concurrently with the restoration of the entire civilian infrastructure system, with a focus on residential units. It’s crucial that the renewed residential areas are constructed to facilitate a more efficient connection to the water and sewage infrastructure.

Long-term perspective:

The reconstruction of Gaza's wastewater treatment system must be strategically planned in alignment with the projected population growth in Gaza. According to UN projections, it is estimated that more than four million people will inhabit Gaza by 2050. Based on a calculation of 120 liters per person per day, the wastewater treatment system will need to accommodate approximately 564,000 cubic meters of wastewater daily by 2050. For comparison, the treatment facilities operating in Gaza prior to the war could process about

200,000 cubic meters per day (with the actual treatment volume being lower). Therefore, looking ahead, doubling the capacity will be necessary, along with the construction of transmission systems to enable the connection of broader areas to the wastewater treatment system.

Following the essential upgrades to the wastewater treatment system, which primarily include connecting households to the system, enhancing facilities' performance, and exploring the potential treatment of Gaza's wastewater in Israel for reuse in the Gaza Strip, planning for the sewage infrastructure should prioritize extensive reuse of effluent water for agriculture. This approach will enable Gaza's farmers to utilize high-quality treated wastewater for agriculture purposes, thereby freeing up freshwater resources for human consumption.

Healthcare

Pre-war status quo

Under the Oslo Accords, the Palestinian Authority was entrusted with the responsibility of providing medical care in the Gaza Strip. However, it heavily relied on referrals for medical treatment in Israel.[15]

Infrastructure:

- Prior to the war, Gaza's healthcare system comprised 40 hospitals, 80 primary care centers, and 388 medical treatment points in refugee camps.16 Of these, 35 hospitals were fully operational, with a total of 3,412 beds serving a population of over 2 million. This equates to a maximum ratio of 1.55 beds per 1,000 inhabitants.17

- Of the primary care centers, UNRWA operated 23, offering outpatient services, treatment for non-communicable diseases, medication, vaccinations, pregnancy and postpartum care, bandaging, and injury treatment.[18]

Health status:[19]

- Non-communicable diseases such as cancer, strokes, heart attacks, diabetes, and kidney failure were the leading cause of death in the Gaza Strip in 2022.

[15] Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan, WHO

[16] Health Cluster. *Occupied Palestinian territory.* 2023. Health Cluster. https://healthcluster.who.int/countries-and-regions/occupied-palestinian-territory

[17] Hussam Mahmoud and Samer Abuzerr. *State of health-care system in Gaza during the Israel-Hamas war.* December 1, 2023. The Lancet. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)02634-X/fulltext

[18] UNRWA. *UNRWA situation report #80 on the situation in the Gaza Strip and the West Bank, including East Jerusalem.* February 21, 2024. UNRWA. https://www.unrwa.org/resources/reports/unrwa-situation-report-80-situation-gaza-strip-and-west-bank-including-east-Jerusalem

[19]Zeina Jamaluddine, Zhixi Chen, Hanan Abukmai, Sarah Aly, Shatha Elnakib, Gregory Barnsley, Fiona Majorin, Hannah Tong, Tak Igusa, Oona MR Campbell, Paul B. Spiegel, Francesco Checchi and the Gaza Health Impact Projections Working Group 5. *Crisis in Gaza: Scenario-Based Health Impact Projections.* February 19, 2024. https://gaza-projections.org/gaza_projections_report.pdf

- Malnutrition indices among children aged 6-59 months were relatively low: global acute malnutrition (GAM) was at 3.2%, while severe acute malnutrition (SAM) was at 0.4%.

- More than 485,000 children were diagnosed with mental illness, with 20,000 requiring specialist mental health services and medication. Four out of five children were diagnosed with depression, and/or suffering from grief and fear. The prevalence of PTSD/anxiety/severe depression was increasing among children.

- In the period from 2018 to 2019, 68.2% of current or former married women reported experiencing domestic psychological aggression, 27.5% reported physical abuse, 27.1% reported economic violence, and 11.3% reported sexual violence.

Wartime situation (as of March 2024)

Infrastructure:

- As of February 18, 7 out of 23 UNRWA health centers were operational, distributed as follows: one in the northern Gaza Strip, two in the central Gaza Strip, one in Khan Yunis, and three in Rafah. These centers were staffed by 631 medical personnel, with an additional 300 UNRWA medical personnel working in the refugee camps. UNRWA also provides mental health and psychological support services in the central Gaza Strip and Khan Yunis.[20]

- As of February 26, 24 out of the 40 hospitals were completely inactive, three were fully operational, 12 were partially operational, and two were minimally operational. Of the 80 primary care centers, 19 remained partially operational, while 116 of the 388 medical treatment points in refugee camps remained active.[21]

Health status:

- As of February 15, over 28,000 Palestinians, including Hamas members, had been killed, with 68,000 injured. Approximately 75% of Gaza's 2.2 million people were displaced, residing in overcrowded camps with limited water, sanitation, and food.

- Damage to health services led to increased mortality from non-communicable diseases, resulting in 1,680-2,680 additional deaths.

- Deaths from injuries and trauma affected all demographics, with 34% of fatalities occurring in children aged 0 to 15. Among adults, 57% were men and 43% were women.

- As of February 7, malnutrition indices among children aged 6-59 months had significantly worsened, with GAM at 14.1% and SAM at 2.8%.

[20] UNRWA. *UNRWA situation report #80 on the situation in the Gaza Strip and the West Bank, including East Jerusalem.* February 21, 2024. UNRWA. https://www.unrwa.org/resources/reports/unrwa-situation-report-80-situation-gaza-strip-and-west-bank-including-east-Jerusalem

[21] Health Cluster. *Occupied Palestinian territory.* 2023. Health Cluster. https://healthcluster.who.int/countries-and-regions/occupied-palestinian-territory

- Stress and privacy infringements on nursing mothers contributed to increased fetal and infant mortality.[22]

- Between 17,000 and 18,000 children have lost one or both parents, and the homes of over 450,000 children have been damaged or destroyed.[23]
- Food security has severely declined.24 From Dec. 8, 2023, to Feb. 7, 2024, Gaza's entire population (approximately 2.2 million) faced IPC Phase 3 or higher (severe food insecurity), with 50% of the population classified as IPC Phase 4 (emergency), and one in four households at IPC Phase 5 (catastrophic). Vulnerable groups such as children, pregnant and lactating women, and the elderly are disproportionately affected.

- Infectious diseases have surged,[25] with outbreaks of hepatitis A and diarrheal diseases attributed to compromised sanitation and water quality. Between Oct. 16, 2023, and Feb. 13, 2024, there were 312,693 reported cases of acute respiratory infection, 222,620 cases of acute watery diarrhea (117,989 among children under 5), 74,712 cases of scabies and lice, 49,052 cases of skin rashes, 6,625 cases of chickenpox, and 8,829 cases of acute jaundice.

The six-month forecast compiled by the London School of Hygiene and Tropical Medicine and US-based Johns Hopkins University predicts:[26]

- Covid-19, influenza, and pneumococcus are anticipated to be the leading causes of death among endemic infectious diseases.

- Cholera, polio, measles, meningitis, and meningococcus could become the predominant causes of mortality if infectious epidemics emerge.

- If a ceasefire occurs, an additional 6,550 deaths or 11,580 are projected in the event of simultaneous pandemics due to poor sanitation, malnutrition, and inadequate health services.

- If hostilities persist, another 58,260 deaths are anticipated, or 66,720 if pandemics occur, with traumatic injuries being the primary cause of death.

- If the fighting escalates, the projected death toll could reach 74,290, or 85,750 if pandemics occur, with traumatic injuries expected to be the primary cause of death.

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[22] Zeina Jamaluddine, Zhixi Chen, Hanan Abukmai, Sarah Aly, Shatha Elnakib, Gregory Barnsley, Fiona Majorin, Hannah Tong, Tak Igusa, Oona MR Campbell, Paul B. Spiegel, Francesco Checchi and the Gaza Health Impact Projections Working Group 5. *Crisis in Gaza: Scenario-Based Health Impact Projections.* February 19, 2024. https://gaza-projections.org/gaza_projections_report.pdf

[23] Ibid

[24] IPC. *Gaza Strip: IPC Acute Food Insecurity November 2023 - February 2024.* December 21, 2023. IPC. https://reliefweb.int/organization/ipc-0

[25] Relifeweb. The Gaza Strip on the brink of a public health catastrophe: Health and WASH Clusters reassert calls for immediate long-lasting ceasefire. February 20, 2024. OCHA

[26] Zeina Jamaluddine, Zhixi Chen, Hanan Abukmai, Sarah Aly, Shatha Elnakib, Gregory Barnsley, Fiona Majorin, Hannah Tong, Tak Igusa, Oona MR Campbell, Paul B. Spiegel, Francesco Checchi and the Gaza Health Impact Projections Working Group 5. *Crisis in Gaza: Scenario-Based Health Impact Projections.* February 19, 2024. https://gaza-projections.org/gaza_projections_report.pdf

EXCESS MORTALITY	TOTAL PROJECTION PERIOD (7 Feb to 6 Aug 2024)		
	CEASEFIRE	STATUS QUO	ESCALATION
Total Excluding Epidemics	**6,550** (4,200 to 11,740)	**58,260** (48,210 to 72,830)	**74,290** (62,350 to 92,650)
Total Including Epidemics	**11,580** (4,200 to 80,370)	**66,720** (48,210 to 193,180)	**85,750** (62,350 to 259,680)

Since January 1, 2024, monitoring has been conducted on diseases with epidemic potential (DEP), including acute respiratory infection, diarrhea in individuals over the age of 5, diarrhea in children under the age of 5, bloody diarrhea, suspected meningitis, acute jaundice, suspected measles, acute flaccid palsy (AFP), neonatal tetanus, suspected mumps, suspected diphtheria, and unusual events. This monitoring observed:

- There has been an increase in all conditions except AFP, neonatal tetanus, and suspected diphtheria.
- Particularly notable is the sharp increase in cases of acute respiratory infection (over 200,000 reported), diarrhea in children under 5 years of age, bloody diarrhea, and acute jaundice.

Recommendations

The guiding principle of these recommendations is to rehabilitate local capabilities and ensure the sustainability of the health system by leveraging local personnel, developing local infrastructure, and fostering partnerships with local professional bodies.

Immediate term:

a) Evacuation of populations from disaster-stricken and conflict-affected areas to suitable living environments is paramount. Priority should be given to establishing sterile evacuation zones that meet SPHERE Standards[27]. Special attention should be given to providing appropriate shelters for vulnerable populations, including children, pregnant women, mothers, the elderly, the sick, the disabled, and the injured.

- Protected areas must be designated to ensure adequate shelter, personal safety, and access to medical personnel for those seeking refuge.
- An organized mechanism must be devised for the evacuation and relocation of vulnerable populations, including those with special needs, from the Gaza Strip to other countries.

b) Stabilizing health conditions

[27] https://handbook.spherestandards.org/en/sphere/#ch007

- In terms of infrastructure: prioritizing the removal of raw sewage from population centers, disinfecting water sources with chlorine while carefully monitoring chlorine levels, and augmenting the supply of clean water for drinking, cooking, hygiene, and sanitation.

- Ensuring access to food to meet nutritional needs in accordance with SPHERE standards.

- Implementing active monitoring of infants' and children's nutritional status and establishing units to treat nutritional deficiencies, including measures to prevent refeeding syndrome.

- Behavioral aspects: engaging the population and providing training of families, including women, on maintaining hygiene and sanitation within shelters, cooking under field conditions during shortages, introducing composting services, and implementing appropriate procedures for their utilization.

c) Reinforcing the health system with staff, clinics, infrastructure, and equipment:

   - Training volunteers and community representatives to administer first aid, offer primary mental health care, support medical teams, dispense basic medications, assist the chronically ill and disabled, and more.

   - Increasing the number of professional medical teams by establishing or expanding field hospitals and mobile primary care clinics, offering emergency and dental care, chemotherapy, and dialysis.

   - Providing medical protective equipment for healthcare workers.

   - Providing emergency medical supplies such as field beds, medications, and life-saving and emergency medical equipment.

   - Supplying necessary medical equipment including mobile imaging devices, oxygen concentrators, and more.

   - Ensuring the availability of medications for individuals with chronic conditions (such as diabetes, hypertension, heart disease, cancer, and organ transplant recipients).

d) Vaccinations. Given the prevalence of infectious diseases within the population, vaccination campaigns are imperative, particularly in densely populated regions. These campaigns should prioritize children and pregnant women. It's crucial to maintain vaccination records, issue certificates for vaccinated individuals, and ensure central registration of vaccinations.

e) Management of family health records, including vaccinations, morbidity, medications, nutritional status, and unique needs should be implemented to ensure comprehensive healthcare management.

f) Regular health and environmental monitoring. Monitoring efforts, currently spearheaded by the World Health Organization, should persist under the auspices of this reputable organization, maintaining close contact with Israeli health

authorities. Comprehensive monitoring of health and environmental conditions should encompass:

- Assessing the nutritional status of children aged 0-56 months using ABA growth curves;
- Ongoing surveillance of Diseases of Epidemic Potential (DEP) ;
- Monitoring of pests and stray animals;
- Monitoring of environmental pollutants, including waste, sewage, and ammunition;
- Continuation of the Health Resources and Services Availability Monitoring System (HeRAMS) to evaluate and enhance existing healthcare infrastructure.

g) Introduction of digital records management and digital infrastructure for telemedicine to facilitate the sharing of medical information, enabling telehealth services by partnering organizations.

h) Treatment of prevalent diseases among the population, including respiratory diseases, gastrointestinal tract infections, and skin infections

Intermediate phase after the cessation of hostilities:

a) Mental Health Care:

- Training non-medical personnel (such as teachers, community leaders, social workers, etc.) to monitor and provide mental health care;
- Establishing community centers to treat victims of trauma.

b) Establishing outpatient clinics to treat individuals with chronic conditions (such as diabetes, asthma, and cardiac diseases) and the elderly, ensuring consistent access to medical services and medications.

c) Restoring the vaccination routine to pre-war levels, prioritizing diseases prone to outbreaks during emergencies (such as MMR/ DTP/polio). Reintegrate health service workers, historically responsible for vaccination campaigns and familiar with Gaza's vaccination regime, through civil society organizations. Establish safe areas for vaccination and introduce mobile vaccination clinics.

Long-term perspective:

a) Health infrastructure rehabilitation:
- Establishing hospitals and treatment centers in safe areas;
- Establishing community health systems including primary care and preventive medicine clinics, mother and child service stations, front-line triage services, points for emergency services and dispatch of emergency teams, and pharmacies.

- Ensure a consistent supply of medical equipment and medicines, both to major treatment centers as well as to individuals in the community.

b) Rehabilitate the health system with a focus on continuity of care and follow-up. Implementing a uniform digital documentation system would facilitate information transfer between treatment facilities, remote consultations, and continuous treatment. However, this requires rehabilitating the data infrastructure in the Gaza Strip.

c) Establish appropriate monitoring and control systems to gain a comprehensive understanding of the health status and support the re-planning of the health system. This should encompass monitoring infectious morbidity (such as cholera, polio, measles, meningitis meningococcus), chronic morbidity (such as cardiac morbidity, diabetes, asthma), mortality rates by cause, and quality indicators of the health system.

d) Establish dedicated mental health treatment centers for a significant number of victims, integrating mental health services into community treatment centers, and embedding mental health support within schools with a focus on child development.

e) Collaborate with training programs and vocational schools abroad, as well as international organizations, to offer training opportunities for Gazan health professionals to enhance their knowledge and skills. Implement field training programs to equip local teams with necessary knowledge and tools.

f) Reestablish cooperation with the Israeli health system, including establishing a mechanism for transferring complex patients or those in need of specialized treatment to Israel. Facilitate training for medical teams in Gaza and foster collaboration with professional health system planning and managing bodies to support the rehabilitation of the health system and healthcare services in the Gaza Strip.

g) Environmental Health:

- Establishing long-term residential areas for displaced persons with an emphasis on sanitary living conditions, avoiding overcrowding, ensuring access to safe water and food, and the removal of hazardous materials such as metals, asbestos, and ammunition.

- Implementing measures to control disease-carrying organisms such as mosquitoes, ticks, and flies, including pest control, providing appropriate protective measures, and educating the population on preventive measures.

- Managing stray animals, including monitoring for diseases that pose a risk to humans, administering vaccinations, and providing necessary veterinary treatments.

Potential implementation partners

Several mechanisms should be examined in the near term to address healthcare needs in the Gaza Strip. This includes expanding the medical services provided by existing field hospitals such as the Kuwait Hospital, the UK Field Hospital (UK-MED), Jordan's field

hospitals, as well as the UAE and Turkish field hospital. Additionally, international health organizations, some of which are already present in Gaza, should be bolstered to expand their range of health services and take on additional roles in population training, preparing digital files, vaccination campaigns, and more. These organizations include the World Health Organization, Care International, and International Medical Corps. Other health organizations operating under the auspices of various countries (such as MdM France, MSF Belgium, the Norwegian Aid Committee) can also be engaged for specific tasks such as procuring medical equipment and establishing day clinics.

D. Summary

Many professionals in the field of life-sustaining infrastructure for energy, water, sewage, and public health recognize the urgent need for immediate action to address the crisis in Gaza, alongside the necessity of long-term strategic planning. It's imperative for the political leadership in Israel to mobilize for immediate, large-scale, and coordinated action with its allies. This is crucial to prevent further malnutrition, poor health, and the lack of access to clean water and sanitation in Gaza. Preventing further humanitarian deterioration, and implementing the recommendations outlined in this document are critical not only to address the crisis in Gaza but also to restore Israel's image as a liberal-democratic state committed to security, rather than a perpetrator of unmitigated humanitarian disaster. Simultaneously, it's imperative for Israel to fulfill its obligation to its own citizens by taking significant steps to prevent the escalation of the humanitarian disaster in Gaza, and to invest in its reconstruction. The situation in Gaza directly impacts public health in Israel, posing risks such as the spread of epidemics.

We stress the urgency of implementing our recommendations, as they are crucial for providing immediate relief to the population within a few weeks, and achieving significant improvement within a month or two.

To accomplish this task and implement the recommendations effectively, it is crucial to consult experts from various fields. Seeking assistance from entities with informal ties to the international community, including aid organizations in Israel's neighboring states, Gulf states, and other relevant countries, is also crucial. Establishing links to external factors is essential for finding common ground and partners, and expanding the reconstruction toolkit as much as possible.

The recommendations outlined in this position paper underscore the importance of preventing the humanitarian crisis from worsening, and rebuilding the Gaza Strip in a healthy, sustainable and stable manner, aligning with the shared interests of both Gazans and Israelis. Diplomatic and political considerations could either facilitate or hinder the implementation of these recommendations. It is vital to examine existing and potential mechanisms and swiftly act on the recommendations to address the situation effectively.

In addition to the important issues covered in this document, we must also remember the Israeli hostages still held captive by Hamas. They are directly affected by the conditions in the Gaza Strip and suffer from these conditions disproportionately due to their harsh captivity, social isolation, lack of access to essential medicines and medical care, and other hardships. We hope and pray for their return home as soon as possible.

The document was prepared in cooperation with Mitvim – The Israeli Institute for Regional Foreign Policy and EcoPeace Middle East, in conjunction with a professional forum.

Professional forum members:

- Prof. Nadav Davidovitch, Director of the School of Public Health at Ben-Gurion University and the Taub Center for Social Policy Studies
- Prof. Bruria Adini, Head of Emergency and Disaster Management Studies at Tel Aviv University's School of Public Health
- Prof. Dorit Nitzan, Head of the Master's Program in Emergency Medicine – Preparedness and Response to Emergency Situations and of the Center for Food Systems, One Health and Resilience at Ben-Gurion University of the Negev
- Prof. Orly Manor, School of Public Health, Hebrew University.
- Nathan Lev – PhD student at the School of Public Health at Ben-Gurion University of the Negev and visiting scholar at the Taub Center for Social Policy Studies in Israel
- Ariel Ezrahi is a Non-Resident Senior Fellow at the Atlantic Council. He is also a director in a Fintech fund investing in the energy and climate space. In addition, he is a board member of the MENA2050 Climate Action Committee. Formerly he was the inaugural Director of Energy at the Office of the Quartet and before that the Energy Adviser of Quartet Rep the Rt. Hon. Tony Blair where he was the architect of the Gas for Gaza project.
- Barak Grinpeld -Expert on Palestinian and regional economic affairs, formerly Head of Israeli Liaison at the Quartet Office, and a Co-Founder of the Israeli Ministry of Regional Cooperation
- Bar Rappaport – Coordinator of the Climate Political Sustainability project at the Mitvim Institute and a Hebrew University doctoral candidate on geopolitics and renewable energies.